Analysis of the accommodation response as a supporting tool during subjective refraction

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The refraction process aims to find the combination of sphero-cylindrical lenses that maximizes visual acuity with minimum accommodation. The gold standard technique for assessing refraction is subjective refraction, which includes the control of accommodation by means of fogging technique. Despite the importance of accommodation in the refraction process, there is little knowledge on how the accommodative status behaves during the subjective refraction. For this reason, the main purpose of this work was to analyse the accommodation response during subjective refraction in order to obtain the accommodative status when the patient was wearing the subjective refraction. Moreover, we also aimed to find the relationship of the transition point between relaxed and activated accommodation and the subjective refraction, to determine if the information obtained could be used as a supporting tool for the subjective refraction technique.

Thirty healthy young adults between 18 and 30 years old participated in the study. The accommodation response of the right eye was monitored during a sweep of spherical lenses while wearing the subjective refraction. The set-up to monitor the accommodation consisted of a Hartmann-Shack aberrometer coupled to a phoropter that worked as an open-filed instrument and had a monitoring frequency of 10 Hz [1].

A sweep of lenses from +1.50 D to -1.50 D, in steps of 0.25 D relative to the patient's subjective refraction, was presented in front of the corrected eye while monitoring accommodation. The relative accommodation was calculated as the difference between the value of accommodation measured for each induced power of the sweep of lenses (ΔS) and the minimum measured accommodation. For the subjective refraction, the relative accommodation was obtained for $\Delta S=0$. In figure 1, an example of the accommodation as a function of the sweep lenses is shown, where the solid line represents the measured accommodative response. With the aim to obtain the point of transition between the relaxed and activated accommodation two linear fitting were obtained for each ΔS, the first considering the curve between -1.50 D and ΔS, and the second between ΔS and +1.50 D. In figure 1, the curve fitting for $\Delta S=0$ is shown, corresponding to the dashed lines. The induced power ΔS that produced the best cumulative coefficient of determination was chosen as the transition point between relaxed and activated accommodation, as in Figure 1, indicated with the red point.
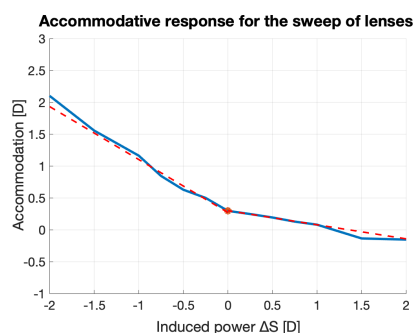

Figure 1. Accommodative response during the sweep of lenses.

The mean relative accommodation $\pm$ SD obtained when wearing the subjective refraction was 0.38 $\pm$ 0.20 D. The agreement between the value of the traditional subjective and the value of refraction that was in the phoropter in the transition of accommodation obtained by means of the linear fitting was analysed with the Bland-Altmann test. The mean $\pm$ SD of the difference between methods and 95% limits of agreement were 0.041 $\pm$ 0.41 D (0.84 D, -0.76 D).

We can conclude that there is a tendency of having a residual activated accommodation with the subjective refraction. Moreover, the point of transition between relaxed and activated accommodation may be a significant information to be used during subjective refraction to enhance the procedure and to detect accommodation-related problems during the visual examination.

[1] C. E. García-Guerra, J. Martínez-Roda, M. Aldaba, S. Galera, C. Aransay, F. Díaz-Doutón, J. Pujol, M. Vilaseca; Real-time monitoring of accommodation during subjective refraction. *Invest. Ophthalmol. Vis. Sci.*;**61**(7):1716. (2020)